

South Dakota, and Wisconsin. 11th, Utah and Washington. 13th, New York and Washington. 14th, Illinois, Iowa, Minnesota, North Dakota, Ohio, Oregon, and Wisconsin. 15th, Illinois, Michigan, New Jersey, North Dakota, Ohio, Pennsylvania, Washington, and Wisconsin. 16th, Arizona, California, Nevada, Oregon, Utah, and Washington. 17th, Arizona, New Mexico, Oregon, and Utah. 18th, Arizona, California, Kansas, Nevada, Oregon, and Washington. 19th, Arizona, California, Nevada, North Dakota, Oregon, South Dakota, and Utah. 20th, Arizona, California, Colorado, Minnesota, Nebraska, Nevada, North Dakota, and South Dakota. 21st, Arizona, Maine, Michigan, Minnesota, Nebraska, Nevada, New Mexico, South Dakota, Vermont, and Wisconsin. 22d, Iowa, Massachusetts, Michigan, Minnesota, New York, Ohio, Pennsylvania, Vermont, West Virginia, and Wisconsin. 23d, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, North Dakota, Vermont, and West Virginia. 24th, Michigan and New York. 25th, New Hampshire, Ohio, and Tennessee. 26th, Kentucky and New York. 27th, Alabama and Nebraska. 28th, Arkansas, Illinois, Indiana, Kentucky, Louisiana, Mississippi, Missouri, South Carolina, and Tennessee. 29th, Connecticut, Michigan, Mississippi, Montana, New Jersey, North Carolina, South Carolina, Virginia, and Wisconsin. 31st, Arizona, Colorado, Minnesota, New Mexico, and Wisconsin.

WET AND DRY PERIODS IN RELATION TO AGRICULTURE.

The Weather Crop Bulletin for the month of March shows that the precipitation was unusually small over all sections east of the Mississippi, and that the month was also very dry in California, but heavy rainfall occurred in northeast Texas, Arkansas, and on the Gulf coast of Louisiana, Mississippi, and Alabama, and also on the coast of Oregon and Washington. As regards rain and snow in relation to agriculture, the following notes are taken from this bulletin, as also from the monthly reports of the State weather services and other sources:

Arkansas.—Late heavy rains have delayed farm work.

Arizona.—Great excess of precipitation; grass ranges and live stock in fine condition; farming operations well advanced.

California.—The northern portion needs rain, but the rest of the State much more so; outdoor work is backward for the lack of rain; grain crop will be short unless spring showers soon come.

Colorado.—Frequent snows favorable for spring work; total snowfall on southern mountains 9 feet, or 2 feet more than last year; grass getting green.

Florida.—Heavy rains delayed planting in the western portion; elsewhere the season is earlier than usual.

Georgia.—Farm work delayed by much rain in the southern portion.

Idaho.—Snow is disappearing rapidly; season opens earlier than usual; little or no farm work done as yet, except in the western sections.

Illinois.—Conditions unusually favorable for farm work up to the 24th.

Indiana.—Wheat wintered well and is far advanced.

Iowa.—During the first twenty days abundant moisture; seeding and plowing far advanced; winter wheat and some spring cereals considerably injured by the weather of the last decade.

Kansas.—Unusually warm and dry; dry weather makes the wheat backward.

Kentucky.—Up to the 25th deficient precipitation and excessive temperature set all crops, vegetation, and farm work three weeks ahead.

Louisiana.—Heavy rains delayed planting.

Minnesota.—Precipitation in excess, especially in the latter half of the month; ground is generally frozen, but soil is gradually getting in good condition; stock wintered well; bees are in better condition than for several years.

Mississippi.—The heavy rains have delayed the season.

Missouri.—Weather unusually favorable up to the 22d.

Montana.—More than the usual amount of precipitation; the snow has but recently melted and farming is not yet begun.

Nebraska.—The first twenty days exceptionally fine and farm work advanced well; winter wheat looks well.

New Mexico.—Weather favorable for farm work; feed abundant; range stock in excellent condition.

New York.—The season is early; soil is in fine condition; grass and grain wintered finely; good maple sugar season.

North Carolina.—The season was forced ahead by the fine weather up to the 26th, when the freeze caused enormous damage.

North Dakota.—Ground covered with snow; very little seeding before the 20th and nothing since.

Ohio.—Weather conditions favorable until the recent cold.

Oklahoma.—Fine weather and abundant rain up to the 24th, when cold and frost set everything back.

Pennsylvania.—First three weeks of fine weather; the cold of last week did little damage; season unusually early; the dryness and slow moderation of the weather greatly in favor of all crops.

South Carolina.—Up to the 24th the abundant moisture in the soil and the midsummer heat advanced the season by two weeks; owing to the frost, replanting will be necessary.

South Dakota.—Precipitation considerably above normal; season unusually early; no material damage by the cold weather of the last week; ample moisture in the ground.

Tennessee.—Precipitation below the normal; up to 23d season two weeks in advance; cold wave of the 26th did great damage.

Texas.—Up to the 20th the season was two weeks earlier than the average, but as a result of the frost is now two or three weeks late.

Vermont.—Month unusually warm and dry, unfavorable for maple sugar.

Virginia.—Until the recent freeze farming was unusually advanced.

Washington.—Rainfall above normal; vegetation backward, but earlier than last year.

West Virginia.—Precipitation below average; vegetation well advanced until the hard freeze and frosts of the 26th and 28th; light snow afforded some protection to the wheat and oats; grass in good condition.

Wisconsin.—Winter grain in fair condition; very little farm work done as yet.

Utah.—Precipitation below the normal, but the large amount of snow in the mountains will give good supply for irrigation for the ensuing season; the spring is backward; Utah escaped the frosts of the close of March.

WIND.

PREVAILING WINDS.

The prevailing winds for March, 1894, viz, those that were recorded most frequently at Weather Bureau stations, are shown in Table I, but are not given on Chart II, as has hitherto been the custom. The summary of State Weather Service reports gives the prevailing winds recorded at voluntary stations in the respective States; these may be summarized as follows:

South.—Alabama, Arkansas, Georgia, Idaho, Illinois, Iowa, Kansas, Louisiana, New York, Oklahoma, Tennessee, Texas.

Southwest.—Arizona, Delaware, Indiana, Kentucky, Michigan, Missouri, Montana, Nevada, New England, North Carolina, Ohio, Oregon, South Carolina, Utah, Virginia, Washington, Wisconsin.

West.—California, Colorado, Maryland, West Virginia, Pennsylvania, Wyoming.

Northwest.—Minnesota, Nebraska, New Jersey, North Dakota, South Dakota.

North.—None.

Northeast.—None.

East.—Florida.

Southeast.—None.

RESULTANT WINDS.

The resultants for the current month, as deduced from the hourly records of winds, by self-registers at about 67 regular Weather Bureau stations, are given in Table VIII. Other resultants, deduced from the personal observations made at 8 a. m. and 8 p. m. at all stations that appear on the morning and evening maps of the Weather Bureau, are given in Table IX. These latter resultants are also shown graphically on Chart II, in connection with the isobars based on the same system of simultaneous observation; the small figure attached to each arrow shows the number of hours that this resultant prevailed, assuming each of the morning and evening observations to represent one hour's duration of a wind of average velocity; these figures (or the ratio between them and the

total number of observations in this month) will indicate the extent to which winds from different directions counter-balance each other. The original north, south, east, and west components, on which these resultants are based, are given in detail in Table IX for convenience in making further studies.

During March the resultant movement from the northwest prevailed over North Dakota, South Dakota, and Nebraska; the movement from the southwest prevailed over Washington, Oregon, northern California, the upper Mississippi Valley, the Lake region, the Ohio Valley, New England, and the south Atlantic States; the movement was from the southeast in Florida and the Gulf States.

HIGH WINDS.

Wind velocities of 50 miles, or more, per hour were reported at regular stations of the Weather Bureau as follows (maximum velocities are averages for 5 minutes; extreme velocities are gusts of shorter duration):

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
		Miles.				Miles.	
Amarillo, Tex.	3	52	s.	Havre, Mont.	14	53	nw.
Do	6	66	sw.	Huron, S. Dak.	14	58	se.
Do	20	50	s.	Do	21	52	ne.
Do	28	60	n.	Keeler, Cal.	17	60	nw.
Do	30	56	w.	Lander, Wyo.	16	60	sw.
Bismarck, N. Dak.	23	53	nw.	Milwaukee, Wis.	11	50	w.
Chicago, Ill.	10	61	nw.	Moorhead, Minn.	24	60	nw.
Do	11	60	sw.	Pikes Peak, Colo.	3	92	sw.
Do	28	54	ne.	Do	9	91	w.
Colorado Springs, Colo.	10	66	nw.	Do	11	91	w.
Davenport, Iowa	10	60	sw.	Do	30	93	w.
El Paso, Tex.	17	52	nw.	Port Huron, Mich.	24	54	w.
Fort Canby, Wash.	1	58	s.	Rapid City, S. Dak.	22	51	n.
Do	7	68	s.	Saint Vincent, Minn.	23	50	n.
Do	8	84	s.	Sault Ste. Marie, Mich.	11	50	nw.
Do	10	78	s.	Shreveport, La.	18	54	nw.
Do	13	54	s.	Tatoosh Island, Wash.	7	50	w.
Do	14	78	se.	Do	11	51	w.
Do	15	54	se.	Tucson, Ariz.	3	51	s.
Do	17	60	s.	Winnemucca, Nev.	9	58	sw.
Do	18	72	s.	Do	16	56	sw.
Do	28	55	se.	Yuma, Ariz.	17	54	nw.
Hatteras, N. C.	29	52	nw.	Do	19	53	nw.

LOCAL STORMS.

4th.—At Abilene, Tex., high wind in the evening caused minor damage. A severe local storm of short duration and moving northeast passed over Rich Hill, Bates County, Mo., at night. The wind blew in heavy gusts attended by heavy rain and small hail. The clouds had a whirling motion and were attended by a continued noise like the rushing of a railroad train. Not much damage was done at this point, but in the surrounding country the loss amounted to several thousands of dollars. Several persons were killed and others injured 7 miles north of Rich Hill. At Sedan, Kans., a wind-storm destroyed outbuildings and damaged farm houses. During a thunderstorm in Woodson County, Kans., stock was killed by lightning. Slight damage was done by a thunder and wind storm at Ashton, Nebr.

6th.—At Sandyville, W. Va., a heavy windstorm did considerable damage to fences. A windstorm, moving from the northwest, in a path 15 feet wide by 100 feet long, passed over Pueblo, Colo., at 5.50 p. m. The storm passed between several buildings at the steel works, turned to the east, describing a small circle around several low buildings. Smokestacks, 45 feet high, on the steel works building were blown down.

8th.—Small buildings were blown down and other damage was done by a windstorm at Le Roy, Colo.

10th.—A thunder and rain storm, accompanied by hail and high wind, occurred at Corsicana, Tex.; buildings were blown down. At Chicago, Ill., a windstorm in the early morning reached a maximum velocity of 61 miles per hour from the northwest. A man was killed by a falling cornice, and

several houses were partially blown down. A severe wind-storm at night uprooted trees and did other damage at Manitowoc, Wis. At Sheboygan, Wis., a wind and rain storm moved southeast, doing minor damage.

11th.—A rain and wind storm, with heavy hail and thunder, occurred at Maple Grove, Ala., at 3.30 p. m.; trees and fences were blown down. At Sault Ste. Marie, Mich., a southwest windstorm reached a maximum velocity of 50 miles per hour; a barn was blown down and a horse killed.

13th.—During a thunderstorm at Damascus, Ala., 2 persons were killed by lightning.

14th.—A severe thunderstorm, moving northwest, passed over Fort Smith, Ark., between 3 and 6.30 a. m. Hailstones as large as pigeon eggs fell for twenty minutes; considerable damage was done to flowers and hothouses.

15th.—A thunderstorm, with heavy hail, occurred at Somerset, Pa.; a barn was struck by lightning. A thunderstorm, with high wind, began at Chattanooga, Tenn., at 7.45 p. m.; damage was done to electric wires. At Cardington, Ohio, a severe thunderstorm occurred in the early morning; a barn was struck by lightning and stock killed. A thunderstorm passed over Cincinnati, Ohio, from 5.45 to 8.30 a. m.; hail fell for a few minutes; damage was done by lightning. During a thunderstorm, in the early morning, at Kilbourne, Ohio, damage was done by lightning. At Winona, Mo., a thunderstorm occurred in the early morning; a man was killed by lightning. A house was struck by lightning at Sedalia, Mo. A report from Salubria, Idaho, states that heavy rain in the mountains caused the Weiser River to overflow its banks, and by the morning of the 16th adjoining lands were covered with water to a depth of 5 feet. Damage was done to property and travel delayed.

16th.—A violent storm, with heavy rain and hail passed over Santa Anna, Tex.; a funnel-shaped cloud, and what resembled a ball of fire, was observed. Five persons were killed and property to the estimated value of \$10,000 was destroyed.

17th.—A heavy rainstorm of short duration, attended by thunder, lightning, and hail, did considerable damage at Bear Lake, Mich., about 2 p. m.; a few miles south a man was struck and two cows were killed by lightning. During a thunderstorm at Evart, Mich., considerable damage was done by lightning. In the evening severe local storms occurred in Texas. A tornado passed over Emory, Tex., in a path 300 yards wide, at 7.20 p. m.; heavy rain fell, accompanied by incessant thunder and lightning; four persons were killed and property valued at \$25,000 was destroyed. At Celeste, Tex., a storm moving northeast, followed by heavy rain, occurred at 8 p. m. A child was killed and damage was done to property. A severe storm, moving northeast, with a funnel-shaped cloud, passed over Corsicana, Tex., at 7 p. m.; in this county seven houses were destroyed. At Jacksonville, Tex., a funnel-shaped cloud moved northeast in a path 300 yards wide about 11 p. m.; damage, \$600. At Rice, Tex., a storm with a funnel-shaped cloud moved northeast, attended by vivid lightning, heavy thunder, and large hail; ten houses were destroyed. At Yuma, Ariz., a wind storm reached a maximum velocity of 54 miles per hour at 4.38 a. m., being the highest velocity ever recorded at that station. Minor damage was done at Fort Yuma.

18th.—At Camden, Ark., a heavy rain and wind storm, with thunder and lightning, began in the afternoon and continued into the night; damage was done by rain. During a thunderstorm at Morrilton, Ark., damage was done to property. At Prescott, Ark., a storm of heavy rain and small hail occurred at 5 p. m.; damage was done to fences and crops. At Martinville, Ark., a thunderstorm, with heavy rain and small hail, moved northeast at 2 a. m.; damage was done to buildings. A report from Lansing, Tex., states that

a violent storm moved northeast between that place and Hallsville at 1.30 a. m., attended by heavy thunder and hail and followed by heavy rain; eight persons were killed, and the damage to property was estimated at \$1,500. The storm occurred at Longview, Tex., about 1 a. m.; a funnel-shaped cloud was observed; heavy hail fell and the thunder and lightning was continuous; damage, \$2,000. At Lufkin, Angelina Co., Tex., a severe storm moved northeast, with thunder, lightning, and rain; it passed through the county in a path about 1 mile wide and 25 miles long; several persons were seriously injured, and considerable damage was done to timber. A storm, with a funnel-shaped cloud and having a whirling motion, moved northeast over Holland, Tex., about 4 p. m.; damage, \$1,000.

19th.—A severe thunder and wind storm occurred at Helena, Ark., at 4.30 p. m.; a funnel-shaped cloud was observed; damage was done to the extent of \$25,000. A storm moved northeast near Lufkin, Tex., about 9 a. m.; it passed 12 miles through the county in a path 50 yards wide; a funnel-shaped cloud, with a whirling motion, was observed; very heavy rain, thunder, and lightning continued all day after the storm; damage to buildings, \$5,000. A storm moving north over Nacogdoches, Tex., about 7 a. m., caused damage to the extent of \$1,000. A severe storm, with a funnel-shaped cloud, moving northeast, passed over the vicinity of Leonard, Tex., at 8 p. m.; heavy rain and large hail fell, and the thunder and lightning was continuous; an infant was killed and a house destroyed. A storm struck Bartlett, Williamson Co., Tex., about 3 a. m.; 2 churches and number of buildings were destroyed. The heaviest rain-storm in years prevailed in the vicinity of Denison, Tex.; all streams overflowed and great damage was done to bridges and farms.

20th.—At New Orleans, La., during a high wind and thunder storm, damage was caused to the extent of \$5,000. A destructive storm passed over the north part of De Soto Parish, La., killing 1 person and destroying several houses. A violent windstorm occurred at Purvis, Miss., at 5 a. m.; damage was done to timber and outhouses and some stock killed. A heavy storm of wind and rain, attended by thunder and lightning, struck Natchez, Miss., shortly after midnight, causing minor damage. A storm of wind and rain visited the vicinity of Lumberton, Miss., during the early morning;

damage was done to fences and trees. High wind in the early morning caused minor damage at Little Rock, Ark.

21st.—During a heavy thunderstorm at Millville, N. J., 1 person was killed and another stunned by lightning. A severe thunderstorm occurred in the west part of Pittsylvania County, Va.; 1 person was stunned by lightning and a house damaged. A thunderstorm occurred at night at Houston, Mo.; a child was struck by lightning. Heavy snow and wind storms prevailed over North Dakota, South Dakota, Nebraska, and Minnesota; in some instances these began on the 19th and continued until the 22d. At Duluth, Minn., a sleet, rain, and wind storm prevailed on the 21st, changing to a heavy snow-storm on the 22d; damage was done to electric wires and trees by the accumulation of heavy ice, and street car traffic was delayed. At Valentine, Nebr., a storm of snow and high wind began at 11 a. m., and continued until the morning of the 22d. The snow drifted badly, delaying railroad traffic and causing loss of stock. At Bismarck, N. Dak., a storm of snow and wind began at 9.40 p. m., 19th, and prevailed until the 21st; all traffic was delayed. The most severe snow and wind storm since March, 1888, began at Rapid City, S. Dak., at 3.10 p. m., and continued during the 22d. All trains were blockaded, business suspended, and the loss of stock was heavy.

22d.—During a thunderstorm at Langley, Va., a barn was struck by lightning and 3 horses were killed. A report from Louisville, Ky., states that severe local storms occurred in Kentucky, along the Ohio River, in the morning. At Owensboro, Ky., a storm, possessing some of the characteristics of a tornado, occurred at 6 a. m.; valuable stock was killed and damage was done to property. A violent downpour of hail occurred at New Albany, Ind., at 6 a. m.; much damage was done. During a thunderstorm in the early morning at St. Louis, Mo., damage was done by lightning to the extent of \$33,000.

23d.—A severe thunder and wind storm passed over Bridgeton, N. J., in a path 100 to 200 feet wide, at 1.30 a. m.; houses and barns were destroyed. During a storm at Washington, N. C., 4 boats were capsized and 2 persons drowned. At Fargo and Fort Berthold, N. Dak., severe snow and wind storms caused loss of stock and damage to property.

24th.—At Crookston, Minn., a windstorm at night caused damage to roofs and electric wires.

ATMOSPHERIC ELECTRICITY.

GENERAL STATISTICS.

The table on page 120 shows in detail for March, 1894, the number of stations from which meteorological reports were received, and the number of such stations reporting thunderstorms (T) and auroras (A) in each State and on each day of the month.

THUNDERSTORMS.

A mention of the more severe thunderstorms reported during the month is given under "Local storms." The dates on which reports of thunderstorms were most numerous were: 4th (188), 14th (106), 15th (243), 17th (133), 18th (166), 22d (190). The States from which the most numerous reports were received were: Louisiana, 143; Missouri, 121; North Carolina, 102; Ohio, 163.

AURORAS.

The evenings on which bright moonlight must have interfered with observations of faint auroras are assumed to be those of the four days preceding and following the date of full moon, viz, from the 17th to 25th, inclusive. On the remaining twenty-two days of the month 782 reports were re-

ceived, or an average of thirty-six per day. The dates on which reports of auroras were especially numerous were: 2d (24), 8th (45), 30th (629), 31st (35); on the 23d, notwithstanding the moonlight, 16 reports were received, mostly from Minnesota, Michigan, Montana, New York, North Dakota, South Dakota, Wisconsin, and, after making a general allowance for moonlight, it seems proper to include the 23d among the dates of frequent auroras.

The aurora of the evening of the 30th was remarkable in several respects. It was visible at 629 stations in the United States, and the few reports that have been published from Canada and Europe show that we can not yet indicate, even approximately, the limits of the area over which it was observed. Its southern limit in the United States is indicated by its visibility at one, two, or three stations in Georgia, Alabama, Mississippi, Arkansas, Kansas, Colorado, Utah, Nevada, Oregon, and Washington. Notwithstanding the fact that many of our third order stations pay no special attention to the reporting of auroras, yet 50 per cent, or more, of the stations in Virginia, Tennessee, Kentucky, Illinois, Michigan, Indiana, Ohio, Pennsylvania, Maryland, Delaware, New